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(54) **DEVICE AND METHOD FOR EQUALIZING THE SUPPLY TO A CARDER OF TEXTILE FIBRES WHICH ARE IN THE FORM OF A MAT**

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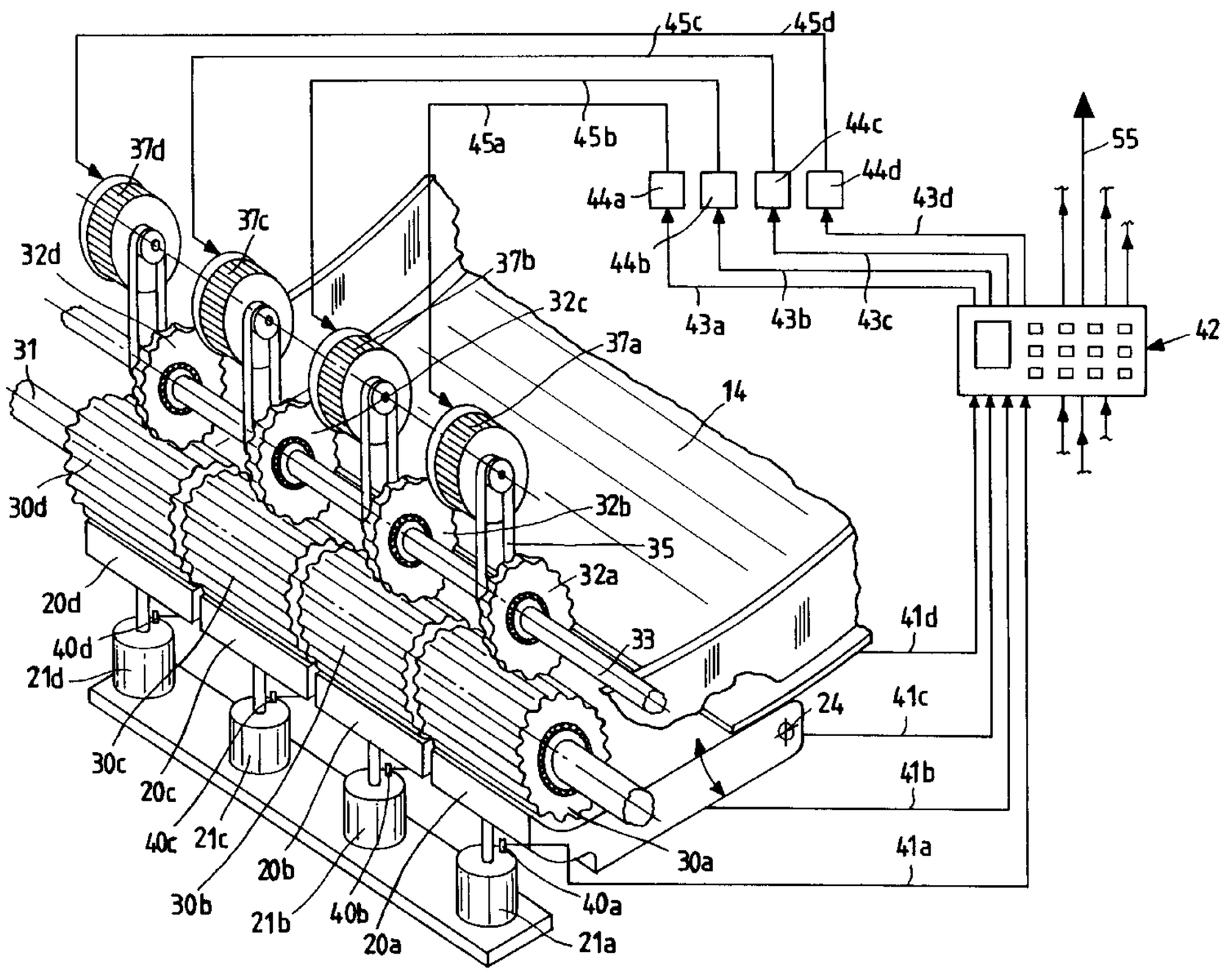
(57) **ABSTRACT**

Device for supply of a mat of fibers to a carder, by means of a slide, which ends by overlapping a plurality of pivoting tables, which are opposite a superimposed roller feed unit, in order to form a plurality of gaps, with individual and continual regulation of the speed of the rollers, according to the quantity of fibers which is present in their gap.

9 Claims, 3 Drawing Sheets



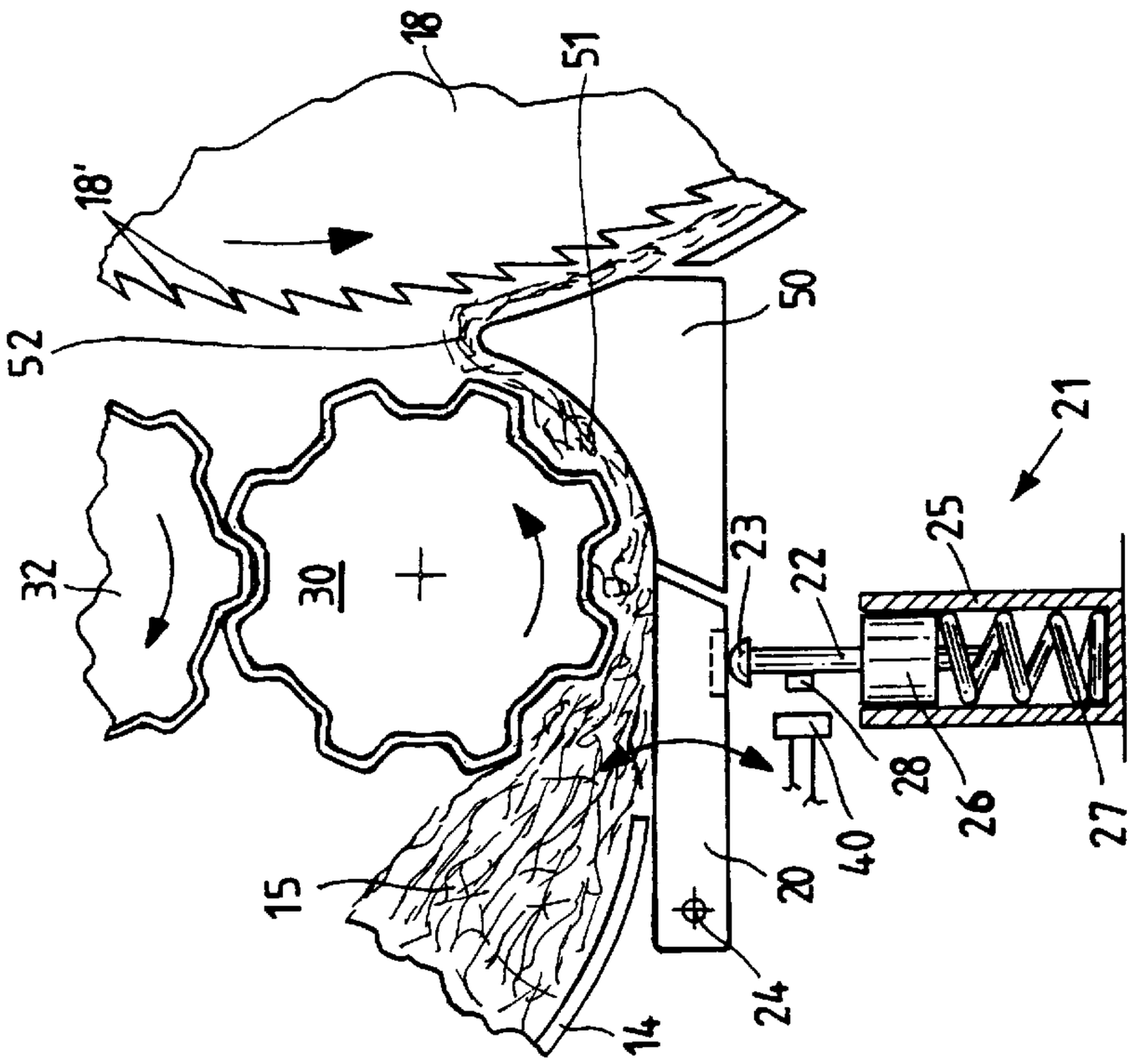
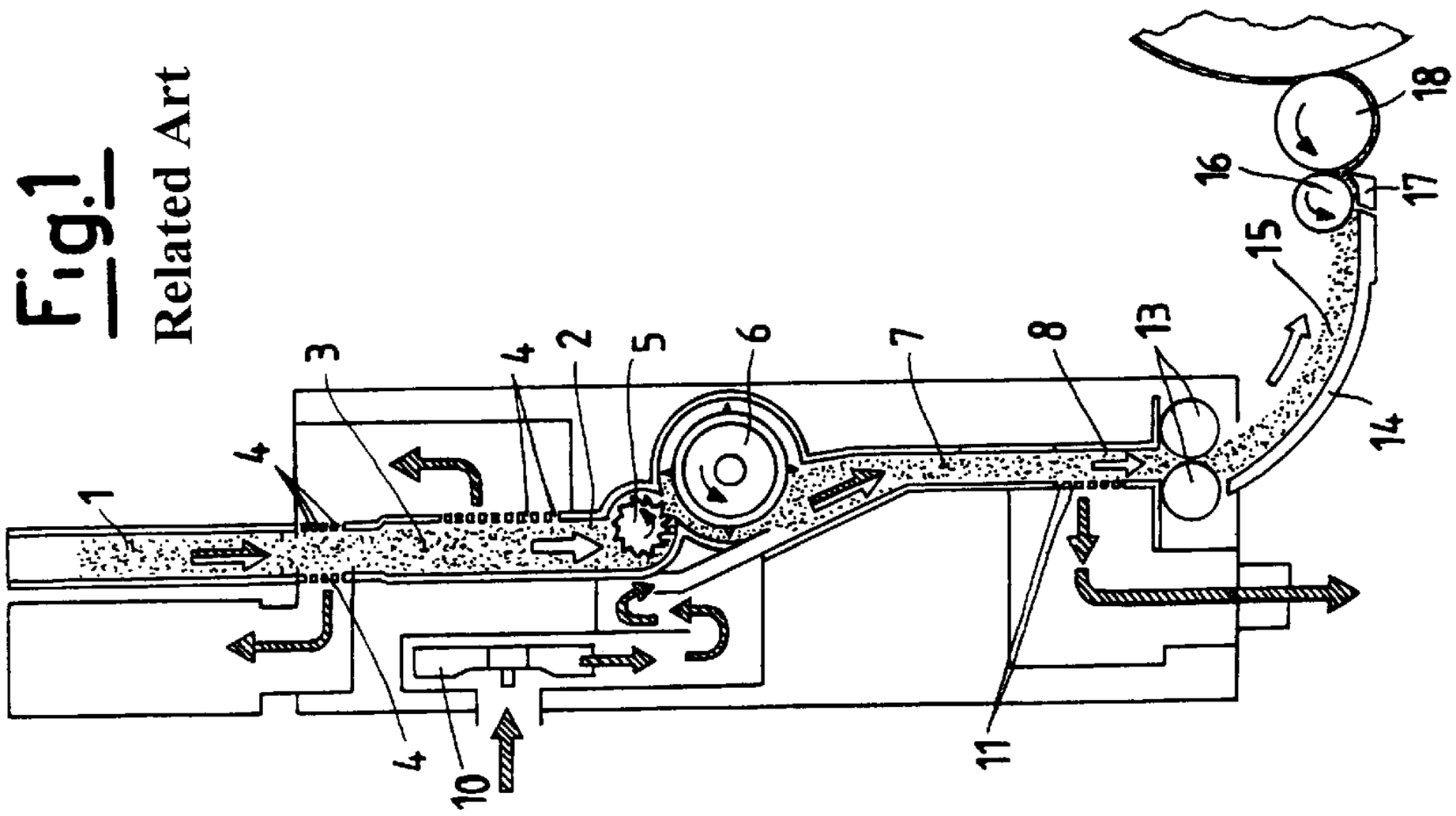
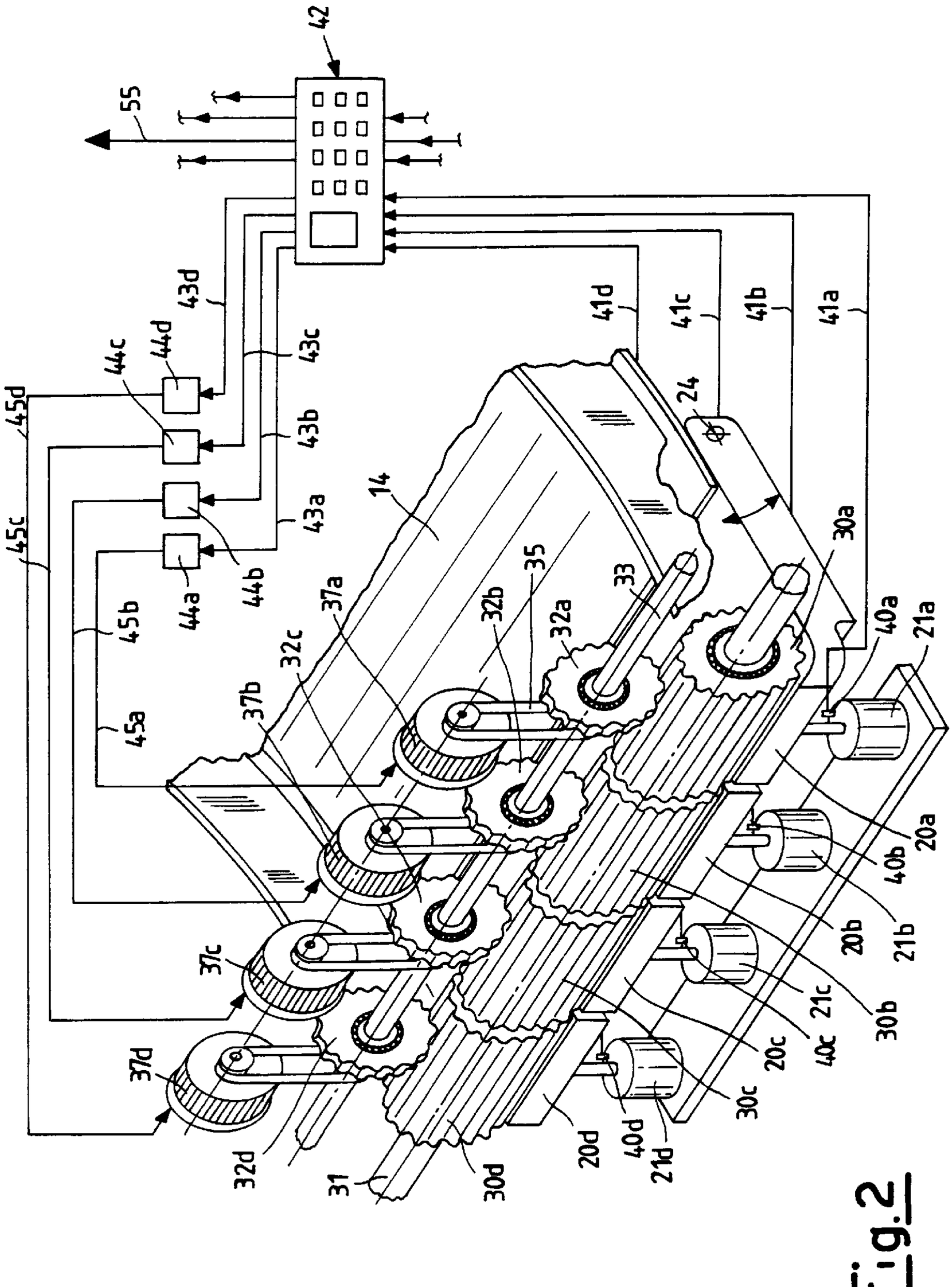


Fig.4

Fig.1
Related Art

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14
30a
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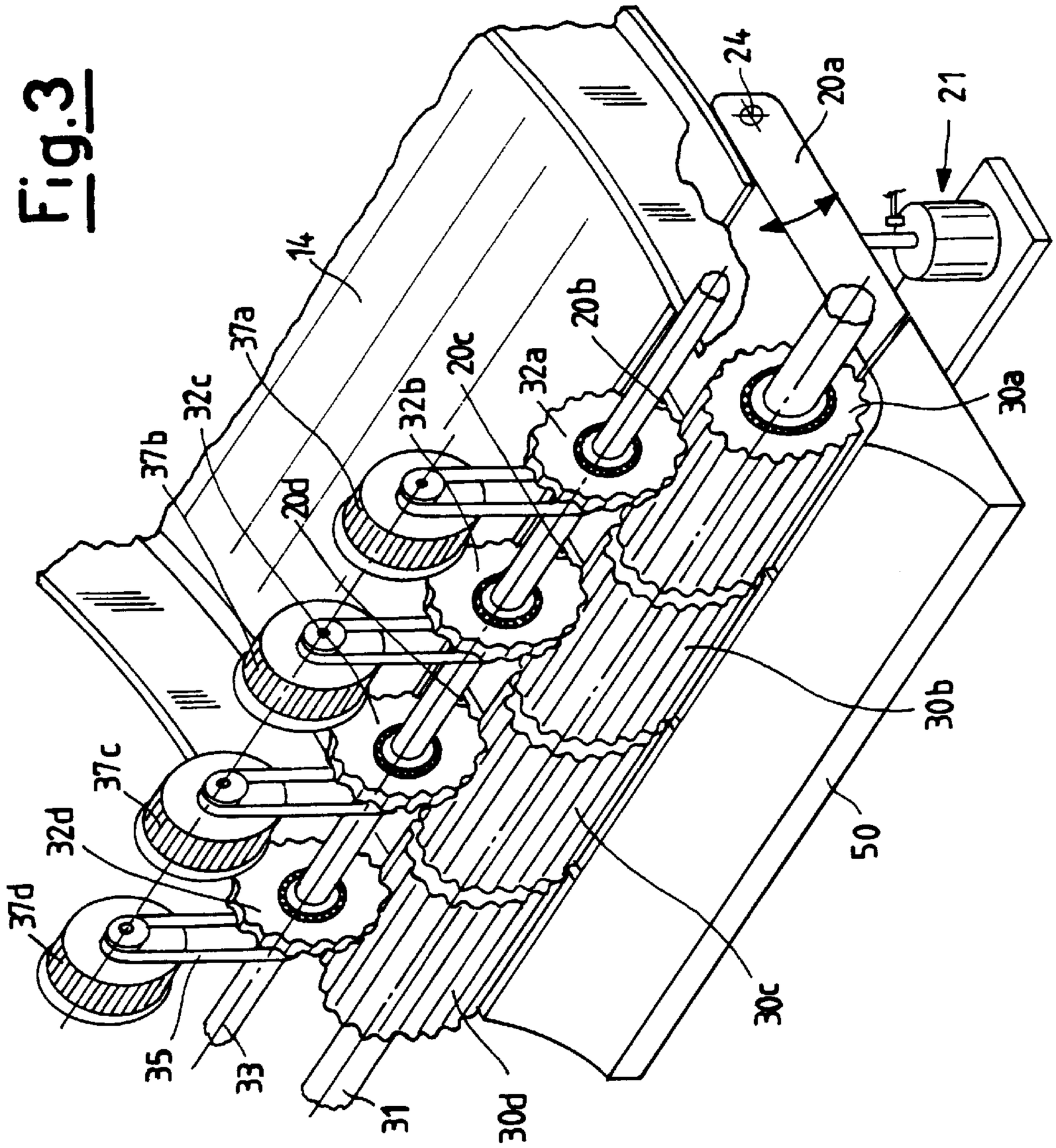
Fig. 2

Fig.3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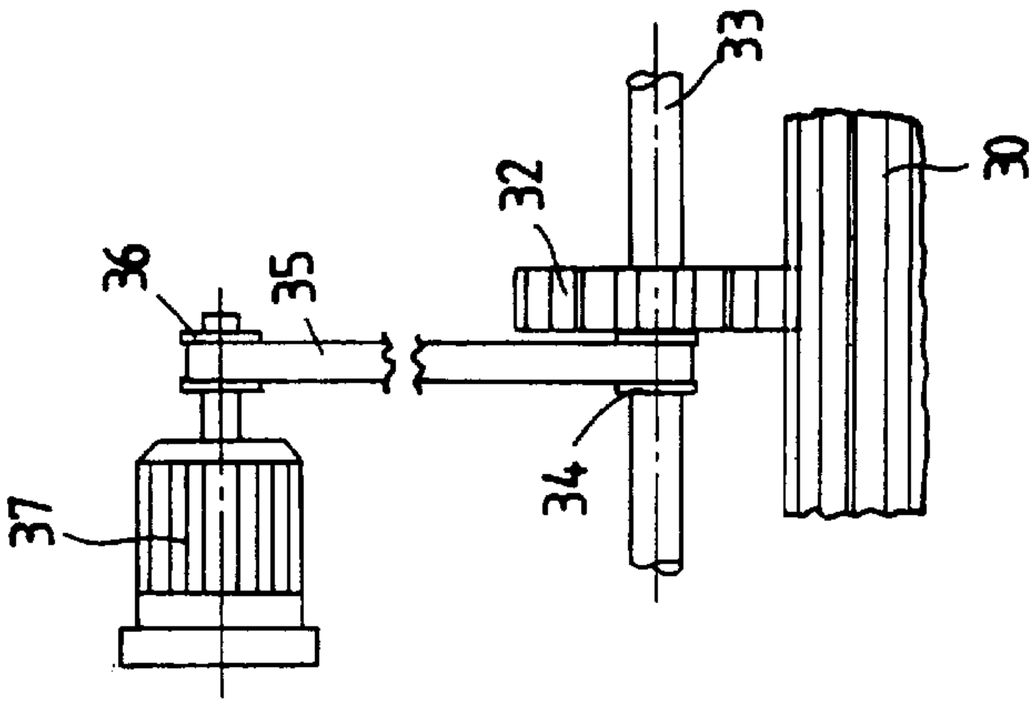
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Fig.5

DEVICE AND METHOD FOR EQUALIZING THE SUPPLY TO A CARDER OF TEXTILE FIBRES WHICH ARE IN THE FORM OF A MAT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to supply to carders, in which a thin layer of fibrous material is worked by a series of surfaces, which are provided with a large number of tips with a variety of shapes, inclinations and levels of stiffness, and are driven with motion relative to one another, by means of which the fibrous material is opened up into the form of individual fibres, the particles of dirt are eliminated, the fibres are mingled with one another, and a non-twisted strip of fibres is formed, to be sent to the successive processing stages.

2. Discussion of the Background

In its most general aspects, the operation of supply to a carder of the cotton-industry type is carried out according to the most significant aspects of the diagram illustrated in FIG. **1**. The light-coloured arrows indicate the flow of flock fibres, whereas the dark arrows indicate the flow of the conveying and control air.

In general, the untreated material **1**, which consists of flock fibres, is obtained from an opener, which is not shown in the figure. It is conveyed by means of pneumatic transport in a current of air, and is accumulated in the end part **2** of the descending duct **3** for intake of the fibres. The transport air is discharged via the apertures **4**; as the fibrous material is deposited in the end part **2**, it covers these apertures, and increases the pressure in the duct **3**. Monitoring of the pressure value in the upper duct makes it possible to measure the level of filling of the chamber or end part **2**. On the basis of the level of filling of the latter, there is regulation of the processing, and of the flock fibres conveyed from the preceding series of openers. If the carding unit consists of a plurality of carders in parallel, the flow of fibres which is conveyed from the opener unit upstream, to the carders downstream, is distributed preferentially to the carders, the ducts **3** of which are least filled, and which thus provide a smaller loss of load relative to the flow of fibres.

Downstream from the end part **2**, there is disposed the supply cylinder **5**, which supplies the flock fibres to the disintegrator cylinder **6**, which breaks up the material. The two cylinders operate with rotation which is consistent with one another, in order to transfer the material to the duct **7** below.

The current of air in order to maintain the pressure in the lower chamber **8** at the end of the duct **7**, is supplied by means of a blower **10**, which supplies a flow of air tangentially relative to the disintegrator cylinder **6**, which air is then discharged via the apertures **11**. In the duct **7**, there is installed a pressure switch, which controls the speed of rotation of the roller **5**, such as to regulate the density of the fibres contained in the chamber **8**, which form the mat supplied to the carder.

The base of the second descending duct **7** is equivalent to conventional storage of fibres in silos, in which the density of the fibres is controlled and regulated by pneumatic effect.

The set of discharge cylinders or lobar rollers **13**, which rotate at a controlled speed, in order to regulate the output of fibres, discharges the fibres onto a slide **14**, which supplies the fibres in the form of a mat **15** to the carder. The machine is provided with a supply roller **16**, which controls

the mat, and presses it against the supply table **17**, and supplies a brush of mat to the actual carder. The first carding step is carried out by the opener cylinder **18**, which is generally known as the taker-in.

The transverse dimension of the mat supplied is compatible wit h that of the carder processing cylinders; for carders of the cotton-industry type, this transverse dimension is in general between 0.7 and 1.5 metres, depending on the models, and it is essential that this mat is of a regular thickness and density along its entire length, such that the strip which is produced by the carder is processed in a homogeneous manner in the transverse direction.

The present invention relates more specifically to a system for supply to the opening cylinders or taker-in of a carder, in order to obtain a supply of flock fibres which is regular over a period of time, and is distributed homogeneously along the entire length of the carder, both over a period of time and in the cross-section of the conveying ducts, even when the density of the fibres varies.

According to the present state of the art, the technical problem of regularity over a period of time, of the quantity of fibres supplied to the carder, has been dealt with, for example, in U.S. Pat. No. 4,275,483 in the name of Robeson, by arranging the horizontal support shaft of the roller **16** on an oscillating system, which is opposite the fixed tables **17**, and forms a guide for conveying the mat towards the taker-in. Depending on the raising thrust exerted by the mat on the roller **16**, which is detected by a corresponding sensor to detect the displacements of the roller, the speed of the supply roller **16**, i.e. the linear output of the mat, is then varied. This system is sensitive to the average density of the fibrous mass which passes moment by moment beneath the roller **16**, but it does not detect in any way whether the fibrous material is well-distributed, and has a homogeneous density in a transverse direction along the entire width of the slide **14**, or whether, in contrast, it is concentrated preferentially on one side of the slide or the other. In fact, it is not possible to prevent preferential paths in the descending ducts, although control of the density by means of the current of air in the two ducts **3** and **7** is designed to make the flow and the density of the fibrous flock material more regular.

The volume of fibres thus supplied to the carder, with its transverse irregularities, is worked with the same intensity of opening and cleaning, along the entire width of the cylinders, and for smaller thicknesses or lower densities this can be excessive, and for greater thicknesses or higher densities it can be insufficient. The carder is intrinsically unable to carry out mingling or homogenisation in a transverse direction of the fibres which are presented to the taker-in. If an irregularity of volume or density occurs at the start of the taker-in, at a specific transverse co-ordinate, in general this re-occurs at the same co-ordinate in the final doffer of the carder, thus giving rise to a strip which has an irregular transverse cross-section, depending on the excesses or lacks of material present in the transverse cross-section of the mat.

In addition to this disadvantage, there is irregular wear of all the fixed and mobile lined surfaces, as well as dirtying and irregular clogging of the linings.

SUMMARY OF THE INVENTION

The system according to the invention is designed to overcome these disadvantages and limitations; it consists of a device, the substantial characteristics of which are defined in the independent apparatus claim, and the preferred

embodiments of which are defined in the claims which are dependent thereon, as well as of a method, the substantial characteristics of which are defined in the independent method claim, and the preferred embodiments of which are defined in the claims which are dependent thereon.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. **1** illustrates a side, diagrammatical view of a related art cotton-industry type carder;

FIG. **2** illustrates a perspective view of an embodiment of a carder according to the present invention;

FIG. **3** illustrates a perspective view of an alternative embodiment of a carder according to the present invention;

FIG. **4** illustrates an enlarged side view of a modified table structure according to the alternative embodiment depicted in FIG. **3**; and

FIG. **5** illustrates a partial front view of a pulley system for the rollers according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In order to illustrate more clearly the characteristics and advantages of the present invention, it is described by way of non-limiting example, with reference to a typical embodiment which is shown in FIGS. **2** to **5**.

The embodiments in the figures show on an enlarged scale the area of supply of the carder, during transfer of the fibres to the taker-in **18**.

In the embodiment illustrated in FIG. **2**, the slide **14** which conveys the mat to the carder supply unit, ends by overlapping a plurality of pivoting tables **20**, which are aligned transversely, and are opposite a superimposed set of feed rollers **30**, which have the same transverse dimension, and are also disposed transversely, such as to form a plurality of gaps between one another. The flow of fibres in the form of a mat **15** which is presented to the taker-in **18** of the carder, travels into the plurality of gaps between the row of tables **20** and the rollers **30**, the speed of which is individually and continually regulated, according to the quantity of fibres present in the gap which corresponds to them, in order to ensure that the same output by weight of fibres passes through each gap. In the embodiment shown by way of example in the figures, the number of pivoting tables **20***a–d* is limited to four, although the transverse dimension of the slide **14**, which corresponds to the width of the taker-in **18**, can be subdivided into a number of conveyor gaps which varies from **3** to **8**.

Each of the tables **20***a–d* is provided with a pressure unit **21***a–d* beneath, which thrusts its own table, in order to raise it against the corresponding roller **30***a–d*, with controlled force. In the detail in FIG. **4**, this pressure unit **21** consists of calibrated springs, although it can consist of equivalent means, for example of pneumatic actuators, which are supplied in parallel with controlled pressure.

In the embodiments illustrated, each pressure unit **21** comprises a rod **22** with a ferrule **23**, for support against the lower surface of the table **20**, which pivots around a pin **24**. The rod **22** is guided inside a vertical cylindrical guide **25**, and is provided with a directional cylindrical stop **26** inside the guide. A calibrated thrust spring **27**, which is disposed between the base of the guide **25** and the stop **26**, thrusts the rod **22** upwards, and forces the table **20** to rotate around its pin **24**, thus compressing the layer of fibres which is above, against the roller **30**.

On each rod **22**, there is provided a level indicator **28**; a corresponding level sensor **40***a–d*, for each rod, detects the corresponding signal, which provides the information concerning the angular position assumed by the table, i.e. the thickness of each of the gaps between the rollers **30** and tables **20**.

Each sensor **40***a–d* is connected by means of a line **41***a–d* to the machine control unit **42**. This in turn is connected by means of the lines **43***a–d* to the inverters **44***a–d*, which control the motors **37***a–d*, which actuate the rollers **30***a–d*, by means of the connections **45***a–d*.

In fact, each of the rollers **30***a–d* is positioned at its own table **20***a–d*, and is mounted idle on a common fixed shaft **31**, with corresponding bearings interposed. The shaft **31** is connected to the frame of the machine. According to a preferred embodiment of the invention, the rollers are machined with a lobar winding surface, in order to obtain a more efficient grip on the mat of fibres **15**, which is conveyed into the gap between the roller **30** and the table **20**. The rollers **30***a–d* are provided with individual rotational drive, at a speed which is controlled roller by roller, according to the command obtained from the control unit **42** of the machine.

In the embodiments which are illustrated by way of example in the figures, this rotational drive is provided by means of clutch discs, which are driven by their own motor, by means of a belt and pulley connection, however this drive can be produced by equivalent means, for example by motors which are disposed in line with the discs themselves.

According to the embodiments illustrated in FIGS. **2** to **4**, the drive is provided by a series of clutch discs **32***a–d*, one for each roller **30***a–d*, which disc is positioned at its own roller, and is mounted idle on a common fixed shaft **33**, which is connected to the frame of the machine. According to a preferred embodiment of the invention, the clutch disks are machined with a lobar winding surface, which is compatible with that of the rollers **30**, in order to obtain more efficient drive on the rollers themselves.

Each of the clutch discs **32***a–d* is provided with a pulley **34**, which is integral with it, and coaxial relative to it, as shown in the detail in FIG. **5**. This pulley **34** is connected by a drive belt **35** to the rotary end pulley **36** of the individual drive motor **37** of the corresponding roller **30***a–d*, in the individual kinematic chain which is provided for each of the four gaps between each table **20** and roller **30**.

In the alternative embodiment which is illustrated in FIG. **3**, the structure of the table **20**, which creates the gap for passage of the fibres conveyed to the carder, is modified, whereas the remaining parts of the device are unchanged. FIG. **4** illustrates this different, modified table structure, as well as the detail of the pressure unit **21** and the position of the taker-in **18**, which receives the fibres conveyed to the carder.

On the other hand, the table **20** in the preceding embodiment according to FIG. **2** is subdivided into two parts, i.e. an initial mobile part, still indicated as **20**, which is subdivided by way of example into four elements **20***a–d*, and pivots around the pin **24**, and a final part **50**, which is fixed and not necessarily subdivided. This final part **50** is disposed on the side adjacent to the taker-in **18**, and is connected to the structure of the machine, such as to ensure in the end part **51** of the fibre conveyor gap, that the brush of fibres **52** which

is presented to the lining **18'** of the taker-in **18**, is always gripped in the same manner, at the same distance, and in the same direction. The thickness of the initial part of the gap can thus be modulated by the quantity of fibre which is present in it moment by moment, whereas the configuration of its final part is not altered.

In order to illustrate the characteristics of the device according to the invention, its functioning and the method of supply which it provides are described in general.

The mat of fibres **15** is obtained from the pair of lobar rollers **13** which rotate at a controlled speed, it descends along the slide **14**, and is gripped between the pivoting tables **20** and the rollers **30**. If the transverse dimension of the mat is irregular in one of the gaps between the table and the roller, as a result of a lack or excess of fibres, the configuration of the table concerned is altered. In general, the range of modulation of the gap between the table **20** and the roller **30** is within an interval of ±4 mm, and preferably ±2 mm.

If there is a lack of fibres at one or more of the gaps between the tables and rollers, the mat **15** has lower resistance to the thrust from beneath, by the pressure unit **21**; the pressure unit predominates, and thrusts upwards its own table, thus limiting the gap in a manner which is proportional to the quantity of fibres $m_{a\text{-}d}$ present in the gap moment by moment. The sensor **40** detects and transmits to the control unit of the machine **42** the signal relating to the reduced quantity $m_{a\text{-}d}$ of fibres present between the roller **30***a–d* and the table **20***a–d* concerned. On receipt of this signal, the control unit **42** of the carder controls the inverter **44***a–d* of the motor **37***a–d*, in order to impart to each roller **30***a–d* an increase in its speed $v_{a\text{-}d}$, such as to maintain constant the output by weight which passes through each gap, i.e. to maintain constant the product $m_{a\text{-}d}$, $v_{a\text{-}d}$ which corresponds to a value of output by weight which is allocated equally to each of the gaps. The linear speed which is transmitted by the roller **30** to the fibres is controlled in a manner which is inversely proportional to the quantity of fibres present in its gap, moment by moment. If, for example, the thickness of this gap is reduced to half the reference value, the corresponding roller **30** is rotated at a rotational speed which is twice the reference value, such as to double the speed of feed of the mat **15** in the section concerned.

In the opposite case, of an excess of fibres, the mat **15**, which is gripped by its roller **30**, has an increased consistency, and thrusts downwards the slider **22** of the pressure unit **21**: the mat predominates, and moves downwards its own table, thus widening the gap, against the resistance of the spring **27**. The sensor **40** detects and transmits to the control unit of the machine **42** the signal to increase the gap, owing to the increased quantity $m_{a\text{-}d}$ of fibres present between the roller **30***a–d* and the table **20***a–d* concerned. On receipt of this signal, the control unit **42** of the carder controls the inverter **44***a–d* of the motor **37***a–d*, in order to impart to each roller **30***a–d* concerned a decrease in its speed $v_{a\text{-}d}$, such as to maintain constant the output by weight which passes through each gap, i.e. the constant management criterion continues to be that of allocating and maintaining unvaried over a period of time the product $m_{a\text{-}d}$ $v_{a\text{-}d}$ in each of the gaps between each pivoting table **20***a–d* and the corresponding roller **30***a–d*: the linear speed $v_{a\text{-}d}$ of the roller is thus controlled in a manner which is inversely proportional to the quantity $m_{a\text{-}d}$ of fibres present in its gap, moment by moment.

According to the embodiment illustrated so far by way of example, the rollers **30** are disposed above the tables **20**, in order to form the regulation gaps. The opposite arrangement is equivalent, and constitutes an alternative embodiment of the invention.

By means of this arrangement, which is substantially overturned relative to the preceding arrangement, the device for supply to a carder has the slide **14** which ends by overlapping the feed roller unit **30***a–d* beneath, which is opposite the superimposed unit consisting of a plurality of pivoting tables **20***a–d*, which are aligned transversely, and have the same transverse dimension. The regulation gaps are thus formed; the rollers **30***a–d* are also provided with means for individual, continuous regulation of the speed, according to the quantity of fibres present in the gap which corresponds to the rollers; each of the tables **20***a–d* is provided with a superimposed pressure unit **21***a-d*, which thrusts its own table against the corresponding lower roller **30***a–d*, with controlled force. With each table **20***a–d*, there is associated a sensor **40***a–d*, which supplies a signal relative to the angular position assumed by the table **20***a–d*, i.e. relative to the thickness of each of the gaps between the rollers **30***a–d* and tables **20***a–d*, according to the quantity of fibres present in the gap which corresponds to the table.

The control unit **42** of the machine carries out a plurality of functions, receiving signals from a plurality of other sensors, and controlling its own miscellaneous units. For example, the signals which are received from the plurality of sensors **40***a–d* are further processed in the machine control unit **42**, and, on the basis of the overall flow of fibres of the mat **15** which is detected moment by moment, the control unit also controls the drive of the cylinder **5** which supplies the second chamber **8**, via the connection of the line **55**, in order to regulate the average density of the fibres which reach the slide **14**.

By means of the device according to the present invention, substantial advantages are obtained, of which at least the following should be mentioned.

The device can carry out continuous automatic adjustment of the carder, with a weight of fibre which is constant over a period of time, thus limiting the oscillations of density of the strip, and providing a high level of regularity of the yarn count, with values of CV_t % which can be restricted to 0.5–0.8% on samples of 10 m, in which CV generally indicates the Coefficient of Variation.

The fibrous mass which is supplied to the carder is distributed homogeneously along the entire width of the lined cylinders, and is subjected to the same intensity of processing for opening of the flock, and reduction of the neps. The transverse cross-section of the strip obtained is very regular, and is independent of its irregular density upstream from the machine.

On the fixed and mobile lines surfaces of the carder, there is no accumulation of dirt and irregular clogging, which would accentuate the transverse differences of the strip, and nor is there irregular wear.

What is claimed is:

1. A device for supply of a mat of fibers to an input cylinder of a carder, said device comprising:

a slide configured to receive the mat of fibres;

a plurality of pivoting tables aligned transversely, said slide having an end that overlaps said plurality of pivoting tables, said plurality of pivoting tables being disposed transversely so as to form first gaps therebetween;

a set of feed rollers having a same transverse dimension as said plurality of pivoting tables, said plurality of pivoting tables being positioned opposite said set of feed rollers, said set of feed rollers being superimposed over said plurality of pivoting tables such that a second gap is formed between said set of feed rollers and said plurality of pivoting tables; and

a mechanism configured to provide individual, continuous regulation of rotational speed to said set of feed rollers according to a quantity of fibres present in the second gap, wherein

said plurality of pivoting tables are each provided with an underlying pressure unit that is configured to thrust a corresponding pivoting table with controlled force against a corresponding feed roller, and

said plurality of pivoting tables are each provided with a level sensor that is configured to supply a signal corresponding to an angular position of a respective pivoting table based upon a quantity of fibres present in the second gap.

2. The device according to claim **1**, characterised in that each level sensor is connected to a control unit which in turn is connected to inverters, which control motors that drive the set of feed rollers.

3. The device according to claim **1**, characterised in that the plurality of pivoting tables are subdivided into two parts: an initial, mobile part which is subdivided into a plurality of elements that pivot around a pin, and a fixed, final part that is secured and disposed on a side adjacent to the, input cylinder such that a thickness of the second gap at the initial part between the plurality of pivoting tables and the set of feed rollers can be modulated, whereas the configuration of the final part is not modified.

4. The device according to claim **1**, characterised in that the set of feed rollers are machined with a lobar winding surface.

5. The device according to claim **1**, wherein the plurality of pivoting tables and the set of feed rollers are provided in corresponding pairs of pivoting tables and feed rollers with adjustable gaps therebetween, and the corresponding pairs number in a range from 3 to 8 pairs.

6. Device for supply of a mat of fibres to a carder, which mat is released by a set of discharge cylinders, which conveys the fibres onto a slide, which supplies the fibres to the device for supply to the taker-in cylinder of a carder, characterised in that the slide ends by overlapping an underlying set of feed rollers, which is opposite a plurality of superimposed, pivoting tables, which are aligned transversely and have the same transverse dimension, such as to form between one another a plurality of gaps, the rollers being provided with means for individual, continuous regulation of the speed, according to the quantity of fibres present in the gap which corresponds to the rollers; each of the tables is provided with a superimposed pressure unit, which thrusts its own table with controlled force against the corresponding lower roller; with each table there is associated a sensor, which supplies a signal corresponding to the angular position assumed by the table based upon a quantity of fibres present in the gap between the roller and the table.

7. A method for supply of a mat of fibres to a carder using a device for supply of a mat of fibers to an input cylinder of a carder, the device including a slide configured to receive the mat of fibres; a plurality of pivoting tables aligned transversely, the slide having an end that overlaps the plurality of pivoting tables, the plurality of pivoting tables being disposed transversely so as to form first gaps therebetween; a set of feed rollers having a same transverse dimension as the plurality of pivoting tables, the plurality of pivoting tables being positioned opposite the set of feed rollers, the set of feed rollers being superimposed over the plurality of pivoting tables such that a second gap is formed between the set of feed rollers and the plurality of pivoting tables; and a mechanism configured to provide individual, continuous regulation of rotational speed to the set of feed rollers according to a quantity of fibres present in the second gap, wherein the plurality of pivoting tables are each provided with an underlying pressure unit that is configured to thrust a corresponding pivoting table with controlled force against a corresponding feed roller, and the plurality of pivoting tables are each provided with a level sensor that is configured to supply a signal corresponding to an angular position of a respective pivoting table based upon a quantity of fibres present in the second gap, said method comprising the step of:

controlling rotational speed of each roller of the set of feed rollers in order to maintain a final product ($m_{a\text{-}d}$ $v_{a\text{-}d}$) constant, corresponding to a value of output by weight allocated for the second gap, a linear speed ($v_{a\text{-}d}$) which is transmitted by the set of feed rollers to the fibres being controlled in a manner which is inversely proportional to the quantity which is measured moment by moment, of fibres ($m_{a\text{-}d}$) present in the second gap.

8. Method according to claim **7**, characterised in that a control unit controls moment by moment an inverter of a motor used to drive the roller, in order to impart to each roller an increase in its speed ($v_{a\text{-}d}$), corresponding to a decrease of the quantity measured of fibres ($m_{a\text{-}d}$) present in the second gap.

9. Method according to claim **7**, characterized in that a control unit processes the signal received by the level sensors and, on the basis of a flow of fibres as a whole detected moment by moment in the mat, controls the drive of a supply cylinder in order to regulate an average density of the fibres which reach the slide.

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